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EXAMINER	
WILLIAMS, JEFFERY A	

ART UNIT	PAPER NUMBER
2482	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)
	10/590,524	WITTMANN ET AL.
	Examiner	Art Unit
	JEFFERY WILLIAMS	2482

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) 1-19 is/are pending in the application.

5a) Of the above claim(s) 2 is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) 1 and 3-19 is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

Response to Arguments

1. Applicant's arguments filed 10/17/2011 have been fully considered but they are not persuasive.

On page 4 of the applicant's remarks, the applicant argues that the references Richardson (H.264 and MPEG-4 Video Compression: Video Coding for the Next Generation" and Srinivasan (US 2003/0194009) fails to teach the limitation of claim 1 that the coefficients used in a first calculation step are set so that no calculation using more than 16 bits is performed when calculating intermediate values <u>which are not yet rounded in a first direction.</u>

The examiner respectfully disagrees. Srinivasan teaches applying a bicubic filter with coefficients [-4 53 18 -3] to produce a range of intermediate values which equal 14.3 bits. ([0133]). Srinivasan then discloses a rounding (bit shifting) step <u>after</u> the bicubic filter is applied, in a subsequent second filtering step, the rounding step to ensure <u>retention</u> of the 16 bit word limit ([0126]; "the bit shifting ensures retention of precision permitted by 16-bit arithmetic in the intermediate results", [0133]; "subsequent horizontal filtering applying the approximate bicubic filter coefficients to the intermediate values may produce values outside of 16-bit dynamic range, causing overflow. So the intermediate values are shifted....", Srinivasan is stating that the 16 bit limit is not exceeded <u>until the second (subsequent) step</u>, therefore a rounding step is used to keep the 16 bit limit in the second step). Srinivasan further discloses the use of bicubic filters

with no rounding (bit shifting) in the first step which maximizes the use of the 16 bit word limit ([0151]).

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-4 and 7-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Richardson (H.264 and MPEG-4 Video Compression: Video Coding for the Next - Generation Multimedia) in view of Srinivasan (US 2003/0194009).

Regarding **claims 1,12, and 15**, Richardson discloses a motion compensation method comprising:

interpolating sub-pixels in a reference picture (see pg. 173, para. 2) ; and performing motion compensation based on the interpolated
reference picture (see pg. 160, Fig. 6.1, MC block), wherein the interpolating includes:

a first calculation step of calculating intermediate values, which are bases of sub-pixel values of the first sub-pixels, by multiplying, with coefficients pixel values of pixels included in the reference picture (see page 173, equation b=round((E-5F+20G+20H-5I+J)/32); and

a first rounding step of deriving the sub-pixel values of the sub-pixels by rounding the intermediate values calculated in said first calculation step instead of directly using

the intermediate values in calculating sub-pixel values of second sub-pixels(see page 173, equation b=round((E-5F+20G+20H-5I+J)/32) , and

wherein the performing of motion compensation includes

a motion compensation step of performing motion compensation based on the reference picture having the interpolated first sub-pixels with the correspondingly derived sub-pixel values (see pg. 160, Fig. 6.1, MC block),

wherein the first calculation step includes multiplying, with a corresponding coefficient, pixel values of six pixels included in the reference picture (see page 173, equation b=round((E-5F+20G+20H-5I+J)/32),

wherein the first sub-pixels are sub-pixels that are interpolated in a first direction with respect to the reference picture (see pg. 174, Fig. 6.15 part 1), and the second sub-pixels are sub-pixels that are interpolated in a second direction with respect to the reference picture, the second direction being different from the first direction (page 174, Fig. 6.15 part 2).

Richardson is silent about the coefficients used in the first calculation step are set so that no calculation using more than 16 bits is performed when calculating the intermediate values which are not yet rounded in the first rounding step.

Srinivasan from the same or similar field of endeavor discloses no calculation using more than 16 bits is performed when calculating the intermediate values which are not yet rounded in the first rounding step. ([0126], [0133], [0151], [0131]; "in the exemplary implementation described herein, intermediate values are limited to a word limit of 16 bits").

It would have been obvious to one of ordinary skill in the art at the time of the invention to set the coefficients used in the first calculation step so that no calculation using more than 16 bits is performed when calculating the intermediate values which are not yet rounded in the first rounding step to reduce the complexity and the amount of memory needed for the sub pixel interpolation process.

Regarding **claim 3**, Richardson further discloses the motion compensation method according to Claim 1, wherein the interpolation further includes:

a second calculation step of calculating, using the sub-pixel values of the sub-pixels derived in the first rounding step, intermediate values of the second sub-pixels (page 174, Fig. 6.15 part 2);
and

a second rounding step of deriving the sub-pixel values of the second sub-pixels by rounding the intermediate values calculated in the second calculation step (see pg. 174, eq. a=round((G+b)/2).

Regarding **claim 4**, Richardson further discloses the motion compensation method according to claim 3,

wherein the first calculation step includes calculating three intermediate values of a-fourths sub-pixels that are arrayed in the second direction (page 174, Fig. 6.15 part 2 pixels d, f and q), and

wherein the second calculation step includes calculating three intermediate

values of a-fourths sub-pixels that are arrayed in the second direction (See pg. 173, eq. b=round((E-5F+20G+20H-5I+J)/32)).

Richardson goes into detail in describing how to find the base value of one a-fourths sub-pixel (pixel b). However, using the equation that Richardson gives to find the sub- pixel value of pixel b, any number of sub pixels can be calculated.

Regarding **claim 7**, Richardson further discloses the motion compensation method according to claim 6,

wherein the first calculation step includes calculating the intermediate values of the sub-pixels to be interpolated in a horizontal direction, the horizontal direction being determined as the first direction, and

wherein the second calculation step includes calculating the intermediate values of the sub-pixels to be interpolated in a vertical direction, the vertical direction being determined as the second direction (see pg. 174, Fig. 6.15 parts 1 and 2).

Regarding **claim 8**, Richardson further discloses the motion compensation method according to claim 4, further comprising

a bilinear filtering of raising a sub-pixel accuracy by applying bilinear filtering to the reference picture having the interpolated first and second sub-pixels with the correspondingly derived sub-pixel values (see page 173, last paragraph).

Regarding **claim 9**, Richardson further discloses the motion compensation method according to claim 8,

wherein the bilinear filtering includes raising the sub-pixel accuracy of the reference picture from a a-fourths sub-pixel accuracy to an a-eighths sub-pixel accuracy (see pg. 174, last paragraph, pg.175, Fig. 6.17 and equations).

Regarding **claim 10**, Richardson further discloses the motion compensation method according to claim 1,

wherein the first rounding step includes rounding the intermediate values of the first sub-pixels by means of downshifting (see pg. 191, Quantization section and 192, eq.6.7 and the last sentence).

In the Quantization section on page 191, Richardson states "the rounding operation here (and throughout this section) need not round to the nearest integer; for example, biasing the 'round' operation towards smaller integers can give perceptual quality improvements.

Regarding **claim 11**, Richardson further discloses the motion compensation method according to claim 1, wherein the first calculation step includes calculating intermediate values of the first and second sub-pixels that should be arrayed in a horizontal direction and in a vertical direction by multiplying, with coefficients, pixel values of pixels included in the reference picture (see pg. 173, para. 2 sentence 1 and pg. 174, Fig. 6.15 parts 1 and 2 and eq. b=round((E-5F+20G+20H-5I+J)/32). The examiner notes that all of the horizontal and vertical sub-pel pixel values are calcuted in the same manner as "b").

Regarding **claims 13, 14, 16, 17, and 18**, Richardson further discloses a moving picture coding and decoding method comprising:

obtaining a picture to be coded (see pg. 160, Fig. 6.1, block Fn);

interpolating sub-pixels in a reference picture (see pg.159, last paragraph);

performing motion compensation based on the interpolated reference picture (see pg. 160, Fig. 6.1, MC block) ; and

coding a picture based on the reference picture (see pg. 160, Fig 6.1, T, Q, Reorder and Entropy encode blocks),

Decoding a coded picture based on a reference (see pg. 161, Fig. 6.2, Entropy decode block):

wherein the interpolating includes:

a calculation step of calculating intermediate values, which are bases of sub-pixel values of the first sub-pixels, by multiplying, with coefficients, pixel values of pixels included in the reference picture (see page 173, equation b=round((E-5F+20G+20H-5I+J)/32) ; and

a rounding step of deriving the first sub-pixel values of the sub-pixels by rounding the intermediate values calculated in the calculation step instead of directly using the intermediate values in calculating sub-pixel values of second sub-pixels (see page 173, equation b=round((E-5F+20G+20H-5I+J)/32) , and

wherein the performing of motion compensation includes

A motion compensation step of performing motion compensation of the picture based on the reference picture having the interpolated first sub-pixels with the

correspondingly derived sub-pixel values (see pg. 160, Fig. 6.1, MC block), wherein the coding includes

A coding step of coding a differential between the picture to be coded that has been obtained in the picture obtaining and the reference picture of which motion compensation has been performed in the performing of motion compensation (see pg 160, Fig. 6.1, F'n-1 block).

wherein the first calculation step includes multiplying, with a corresponding coefficient, pixel values of six pixels included in the reference picture (see page 173, equation b=round((E-5F+20G+20H-5I+J)/32),

wherein the first sub-pixels are sub-pixels that are interpolated in a first direction with respect to the reference picture (see pg. 174, Fig. 6.15 part 1), and the second sub-pixels are sub-pixels that are interpolated in a second direction with respect to the reference picture, the second direction being different from the first direction (page 174, Fig. 6.15 part 2).

Richardson is silent the coefficients used in the first calculation step are set so that no calculation using more than 16 bits is performed when calculating the intermediate values which are not yet rounded in the first rounding step.

Srinivasan from the same or similar field of endeavor discloses no calculation using more than 16 bits is performed when calculating the intermediate values which are not yet rounded in the first rounding step. ([0126], [0133], [0151], [0131]; "in the exemplary implementation described herein, intermediate values are limited to a word limit of 16 bits").

It would have been obvious to one of ordinary skill in the art at the time of the invention to limit the intermediate values calculated during pixel interpolation, as taught by Richardson, to 16 bits to reduce the complexity of the sub pixel interpolation process.

Regarding **claim 19**, the limitations of claim 19 are rejected in the analysis of claim 1, and claim 19 is rejected on that basis.

Richardson is silent about a non-transitory computer readable medium having stored therein a motion compensation program, wherein, when executed, the motion compensation program causes a computer to perform the method of claim 1 above.

Srinivasan from the same or similar field of endeavor discloses a non-transitory computer readable medium having stored therein a motion compensation program, wherein, when executed, the motion compensation program causes a computer to perform the method of claim 1 above ([0063]; CD-ROMDs and DVDs are examples of non-transitory media).

It would have been obvious to one of ordinary skill in the art at the time of the invention to store a program which when executed, performs the pixel interpolation method disclosed by Richardson, on a non-transitory medium to allow pixel interpolation to be performed in a computing environment.

3. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Richardson (H.264 and MPEG-4 Video Compression: Video Coding for the Next - Generation Multimedia) in view of Srinivasan (US 7,110,459), and further in view of of Sekiguchi et al. (US 2008/0084930).

Regarding **claim 5**, Richardson in view of Srinivasan discloses the motion compensation method according to claim 4.

Richardson in view of Srinivasan discloses all of the subject matter of the claimed invention with the exception of the first calculation step includes calculating the base values of three a-fourths sub-pixels using the following equations when eight pixel values of pixels arrayed in the first direction are represented as A, B, C, D, E, F, G and H respectively and the three a-fourths sub-pixel values are represented as hi, h2 and h3 respectively:

h1 =-l.A+3.B-lO.C+59.D+18.E-6.F+l.G-O.H;

h2 =-l.A+4.B-lO.C+39.D+39.E-lO.F+4.G-1.H;and

h3 =-O.A+l.B-6.C+18.D+59.E-lO.F+3.G-1.H.

Sekiguchi et al. from the same or similar fields of endeavor teaches the above limitation (see pg. 1, col. 2 , [0007]). Sekiguchi discloses a general formula for finding sub pixel values in the horizontal direction. However, one with ordinary skill in the art at the time of the invention would have been able to use the general equation to find 3 a-fourths sub pixel values. It would have been obvious to one of ordinary skill in the art at the time of the invention to use the general equation disclosed by Sekiguchi et al. within the disclosure of Richardson to find three a- fourths sub pixel values, substituting coefficients which would satisfy the equations in the present application, to reduce the operation workload and the simplification of hardware.

4. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Richardson (H.264 and MPEG-4 Video Compression: Video Coding for the Next -

Generation Multimedia) in view of Srinivasan (US 7,110,459) in view of Sekiguchi et al. (US 2008/0084930) and further in view of Etoh et al. (US 20050063466).

Regarding **claim 6**, the rejection of claim 5 is incorporated here within. The rejection of claim 5, however, does not disclose the second calculation step includes calculating the base values of three a-fourths sub-pixels using the following equations when eight pixel values of pixels arrayed in the second direction are represented as D1, D2, D3, D4, D5, D6, D7 and D8 respectively and the three a-fourths sub-pixel values are represented as vl, v2 and v3 respectively:

$v, =-1.D_1+3.D_2-37.-10D_3+59.D_4+18.D_5-6.D_6+1.D_7-0D8;$

$v_2=-1.D\sim +4-D_2-10-D_3+39.D_4+39.D_5-10.D_6+4.D_7-1.D_8$ *;and*

$v_3=-0.D\sim +1.D_2-6.D_3+18-D_4+59-D_5-10-D_6+3.D_7-1-D_{8.}$

Etoh et al. from the same or similar field of endeavor teaches applying a filter with the same coefficients in both the horizontal and vertical directions [0350; “This filter processing is carried out separately in horizontal and vertical directions”. In this case, the coefficients used for the horizontal filter above in claim 5 is used for the vertical filter in claim 6.

Thus it would have been obvious to one of ordinary skill in the art at the time of the invention to use the above equations to find the base values of three a-fourths sub pixels to reduce the operation workload and the simplification of hardware.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JEFFERY WILLIAMS whose telephone number is (571)270-7579. The examiner can normally be reached on M-F 8am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Christopher Kelley can be reached on (571)272-7331. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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